

Citation for published version:

Patel, M 2004, *Metadata Requirements for Digital Museum Environments..*

Publication date:

2004

Document Version

Publisher's PDF, also known as Version of record

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ARCO



Augmented Representation of Cultural Objects

Metadata Requirements for Digital Museum Environments

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Overview

- The ARCO RTD Project
 - Project goals, Prototype systems and components
- Metadata requirements
 - User requirements, Functional requirements, Interoperability and standards, Museum best practice
- Digital capture to virtual exhibition
 - ARCO system architecture, Digitisation of artefacts, 3D modelling and refinement, Storing and managing cultural objects, Designing virtual exhibitions
- Metadata for digital museums
 - ARCO data model, Types of metadata, ARCO Metadata Element Set (AMS)
- Metadata management
 - Metadata schema manager, Metadata instance editor
- Visualisation and interaction
 - Virtual and Augmented reality environments



The ARCO RTD Project

- ARCO started in October 2001 as a three year RTD project
 - Key Action II – Multimedia Content and Tools
 - Action Line III.1.6 – Virtual representation of cultural and scientific objects
- Co-funded by the EC under the 5FP
 - Total investment is 2.8M Euro inclusive of 2.05M Euro from the EC
- 7 partners, including two museum pilot sites, from 4 European countries
 - United Kingdom: [University of Sussex \(coordinator\)](#), [UKOLN@University of Bath](#), [Victoria and Albert Museum](#), [Sussex Archaeological Society](#)
 - France: [Commissariat à l'Energie Atomique](#)
 - Poland: [Poznan University of Economics](#)
 - Italy: [GIUNTI Publishing Group](#)

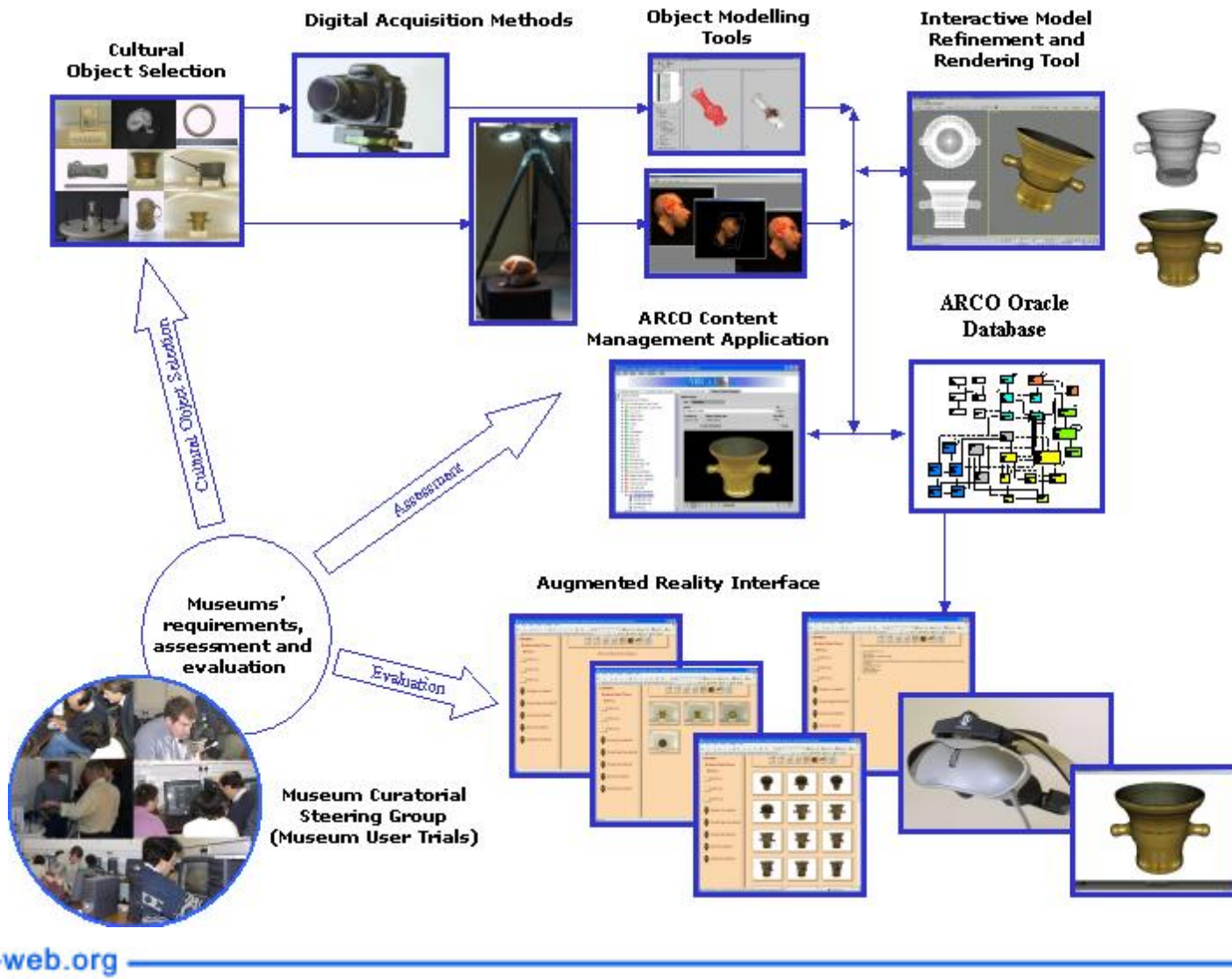


Goals of the ARCO Project

- Develop innovative technology and expertise to help museums **create, manipulate, manage** and **present** cultural objects in virtual exhibitions both within museums and over the Web
- Why?
 - To provide wider access to cultural heritage artefacts
 - To allow museums to have an online (3D) presence
 - To enable interaction with digital representations of collections
- How? By building a set of tools and processes from digitisation to visualisation:
 - Digital capture of artefacts, 3D modelling and refinement, Database and content management, Visualisation in virtual or augmented reality environments
 - Interoperability i.e. an Open Architecture
 - XML Data Exchange between components and other systems
 - Internet, Web, graphics and metadata standards



ARCO Prototype Systems and Components

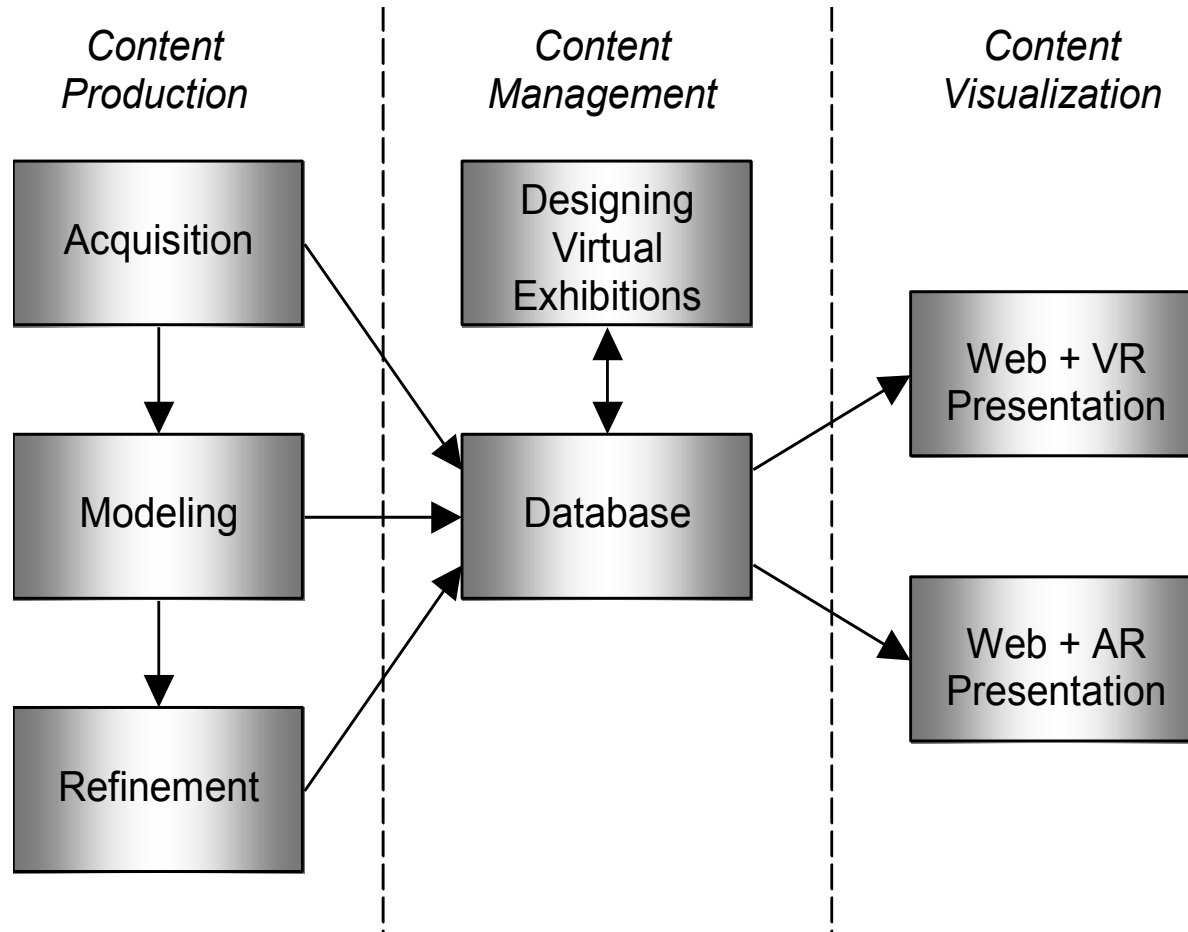


Metadata Requirements for Digital Museums

- User Requirements
 - Museum curator, Cataloguer, Digital Photographer, Object Modeler, Object Refiner, Content Designer, End-user
- Functional Requirements
 - Conversion from physical to virtual representations
 - 3D object representation, manipulation, management, visualisation
 - Design of exhibitions and interactive scenarios
- Interoperability and Standards
 - Internet standards (XML, VRML/X3D, HTML)
 - W3C Recommendations (XML Schema, XSLT, XPath)
 - Metadata standards (mda SPECTRUM, Dublin Core)
 - 3D graphics standards (VRML/X3D, OpenGL, DirectX)
- Museum Best Practice
 - Review of standards, VAM (Picture Library), SussexPast (MODES)



ARCO System Architecture



Digital Capture

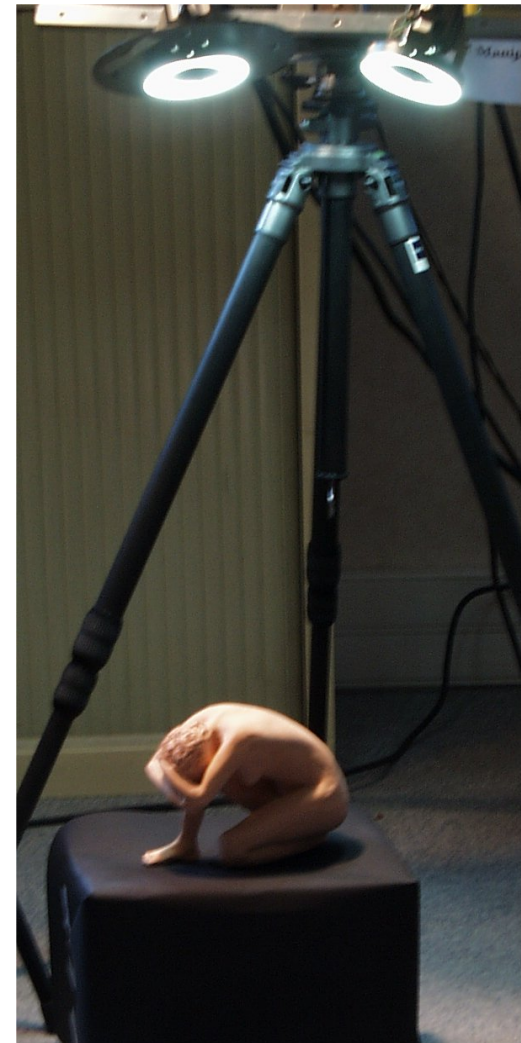
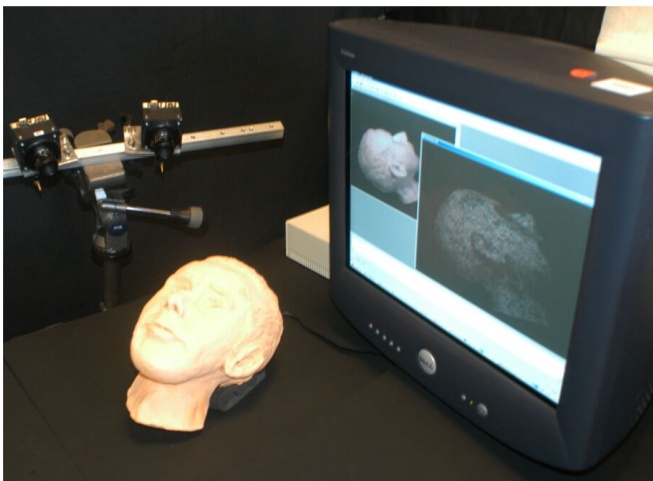
- Method of modelling depends on features of the objects
 - Objects with simple geometry are modelled with modified 3ds max or Maya
- For complex models we use a custom built stereo digital camera system:
 - Result should be an accurate 3D model of the artefact in terms of shape, texture and resolution
 - Automated stereo reconstruction as far as possible
 - No contact between equipment and artefact
 - Artefacts should not be subject to prolonged or harsh lighting conditions
 - Portable in order to gain access to fragile artefacts
 - Ease of use for museum staff who are not experts in 3D measurement



ARCO Object Modeller

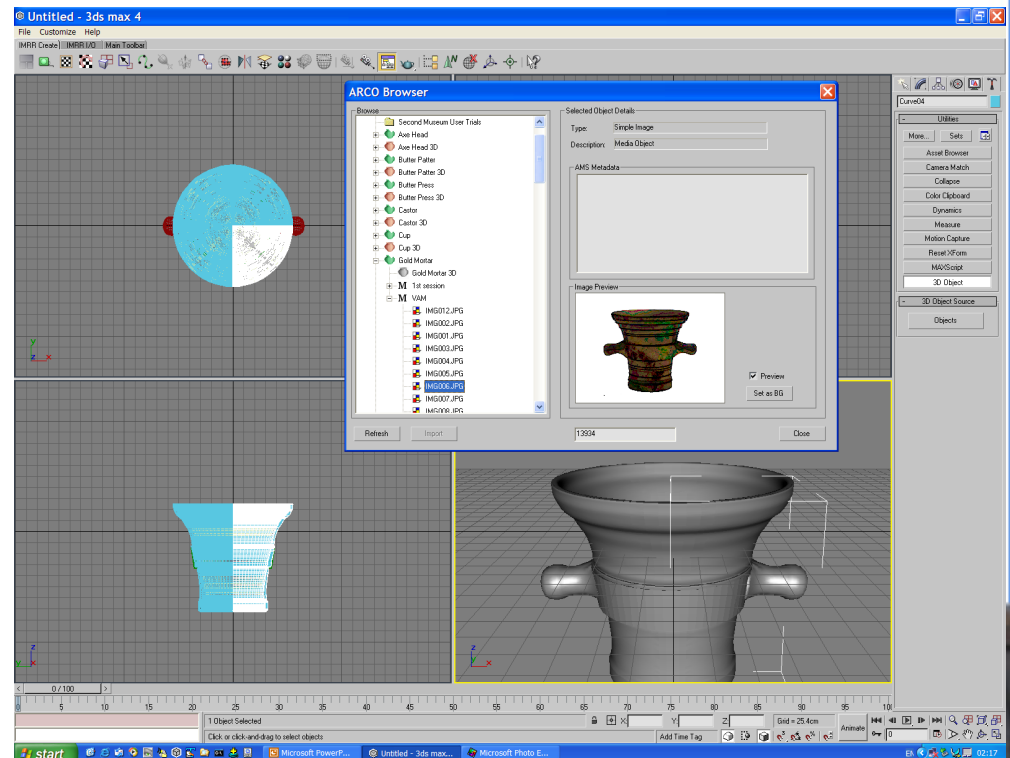
Custom built object modeller comprises hardware and software (stereo photogrammetry):

- Image acquisition combined with structured light projection
- Object geometry and textures are extracted from sequences of stereo images and merged to produce a 3D textured model
- 3D visualisation and model enhancement
- Image registration and merging of 3D meshes
- Export of VRML models



3D Modelling and Refinement

- A tool for interactive model refinement and rendering
 - based on 3ds max
- Creation of simple models and refinement of digitised models
 - smoothing the object geometry
 - reducing polygon count
 - re-applying lighting
 - repairing missing parts
- Database connectivity
 - search and browse objects
 - import and export models (including models generated using other methods, e.g. Mechanical scanning, Laser scanning)



Examples of digitised artefacts

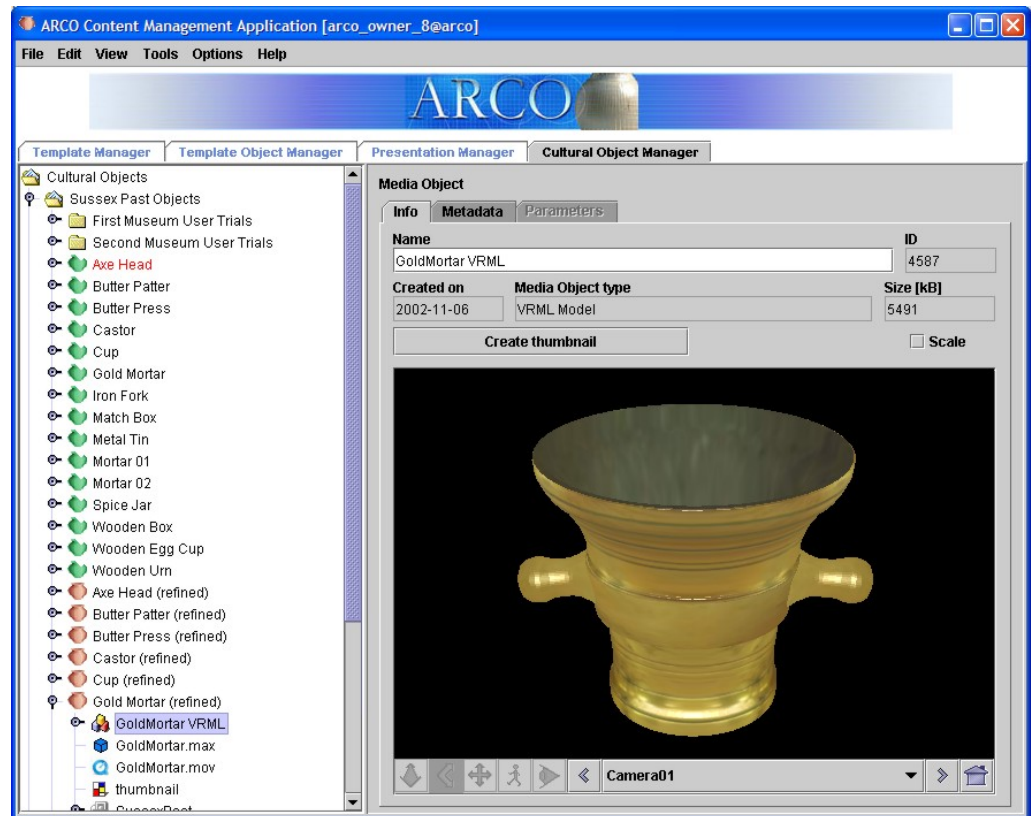
Sample media objects representing cultural artefacts in the database:

- Images from the photogrammetry process
- VRML models exported from model refinement stage



Storing and Managing Digital Objects

- All ARCO data is stored in a database for consistency (Oracle 9i ORDBMS)
- Museums do not manage the database directly, but through a Content Management Application (ACMA)
- Several managers for ease of data manipulation
 - Cultural objects
 - Visualisation templates
 - Virtual exhibitions



Designing Virtual Exhibitions

- Presentation manager in ACMA
- X-VRML – high-level XML-based language for creating dynamic VR models and parameterised presentation templates
- Dynamic creation of exhibitions by combining data and X-VRML templates
- Template instances for:
 - Search interfaces
 - Parameterised browsing
 - Virtual exhibitions
- Presentation Domains
 - Same database content visualised in different ways by applying different X-VRML templates



Virtual Museum Exhibitions

European Art



Europe & America

These galleries show the proliferation of historical styles that were fashionable in the nineteenth century, ranging from Gothic Revival to Neo-classicism and Orientalism.



Gothic Art

Includes Romanesque and Gothic sculpture in stone and wood, with strong holdings of Italian examples, and outstanding examples of Late Gothic textiles, woodwork, and ceramics.



Mannerism ...

Comprehensive collection of sixteenth-century decorative arts and sculpture, including works by Michelangelo and Giambologna.



The Medieval Treasury

A panorama of the small-scale arts of the Middle Ages, including major masterpieces of ivory carving, goldsmiths' work and textiles.



The Renaissance

A rich survey of the Art and Design of the Italian Renaissance, illustrated by celebrated examples of sculpture on both a large and small scale, in marble, stone, terracotta and bronze.



European Art

Gothic Art



See also other rooms:



Mortars



Sculptures



Casket refined

whole:form:cylindrical with fitted domed lid.strapwork handle footed base.engraved legend opposite handle



Cup refined

whole:form:thin wood steamed into cylinder, overlapping ends nailed with a circular base fitted into bottom of cylinder



Gold Mortar refined

whole:from:invert bell shape, flared rim.several courses of incised grooves.lug handles halfway up arising from wider band of coursing

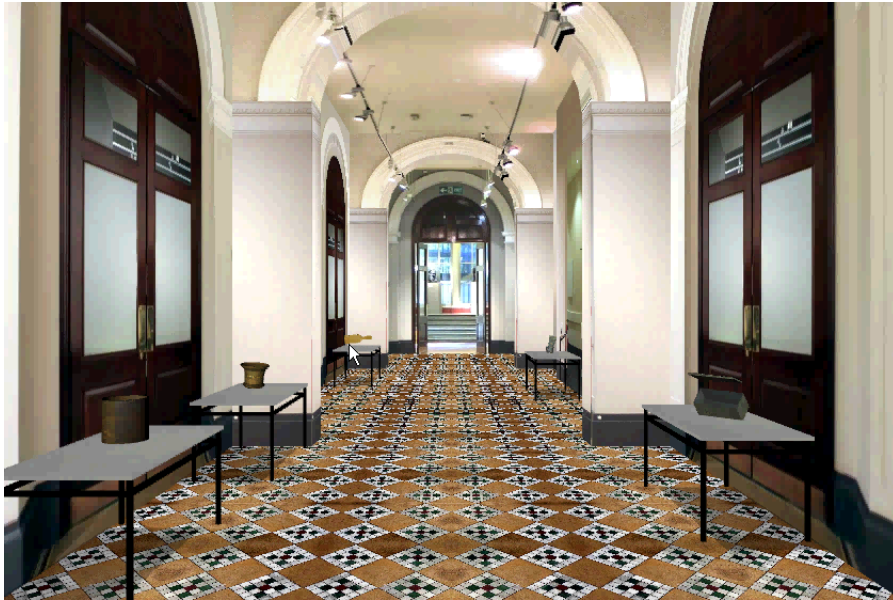


Match Box refined

No object's description



Walkthrough of Museum Exhibitions and Galleries



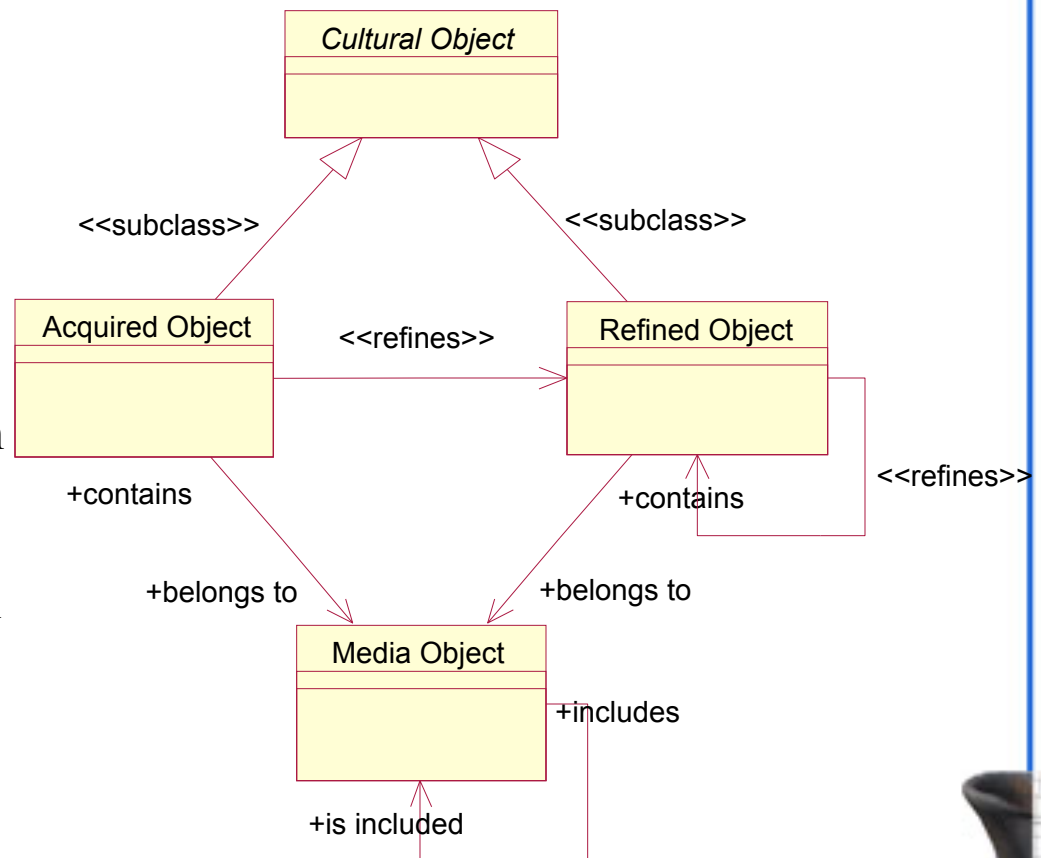
ARCO Data Model

Cultural Object (CO): descriptive curatorial metadata, surrogate for the physical artefact

Acquired Object (AO): digital representation of the physical artefact

Refined Object (RO): acquired (or refined) object which has been modified

Media Object (MO): individual object which makes up a digital representation (3D model, texture maps, description etc.)





ARCO Metadata Element Set

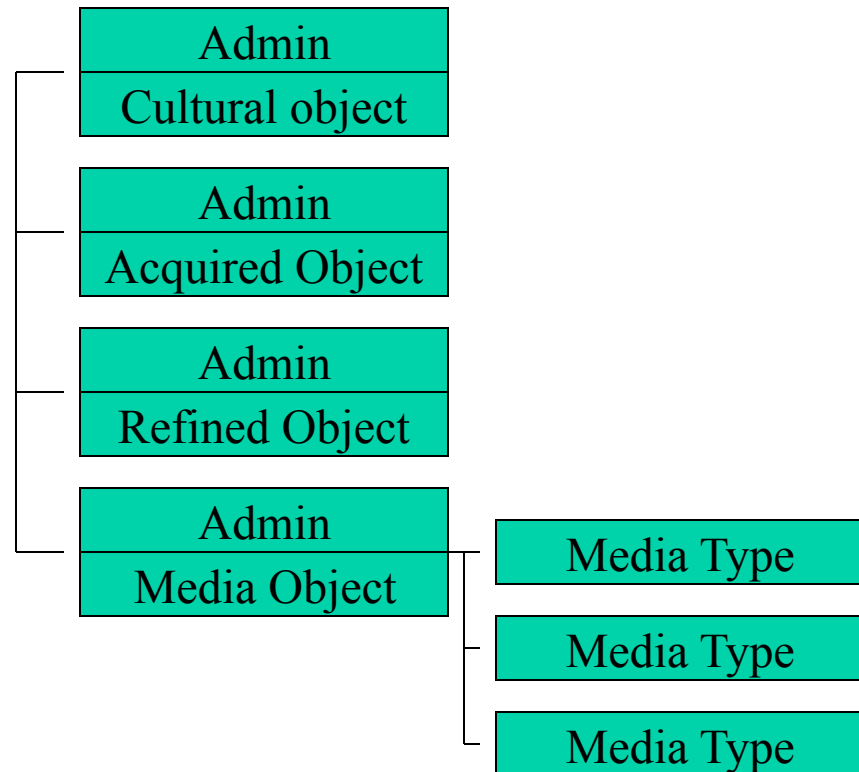
- AMS –ARCO Metadata Schema, is a vocabulary for describing all the processes from digitisation to visualisation:
 - Descriptive curatorial metadata (mda SPECTRUM)
 - Resource discovery metadata (DCMES)
 - Technical metadata (preservation)
 - Themed metadata (intelligence, effort report)
 - ARCO specific elements
- Interoperability
 - Data exchange between ARCO components
 - Cross domain visibility
 - Compatibility with museum best practice
- Implemented with XML Schemas



AMS – Logical Structure

Different groups of users need access to different parts of the metadata (security manager in ACMA):

- Acquired Objects are described by
 - Administrative metadata
 - Cultural Object metadata
 - Acquired Object metadata
- Refined Objects are described by:
 - Administrative metadata
 - Cultural Object metadata
 - Acquired Object metadata
 - Refined Object metadata
- Media Objects are described by:
 - Administrative metadata
 - General Media Object metadata
 - Media Type Specific metadata (six media types at present)



AMS Vocabulary Terms (1)

Type of Metadata	AMS Vocabulary Terms
Administrative	Creator, Date Created, Date Modified
Cultural Object	Source, Name, Name Alternative, Creator, Contributor, Object Production Date, Object Production Place, Type, Description, Rights, Completeness, Condition, Production Period, Production Technique, Material, Dimension, Components, Owner, Acquisition Source, Accession Date, Field Collection Date, Field Collection Method, Field Collection Place, Field Collector, Current Location, Accession Date, Field Collection Date, Field Collection Method, Field Collection Place, Field Collector, Current Location
Acquired Object	Identifier, Name, Creator, Contributor, Publisher, Date Created, Description, Rights, Format, Format Extent
Refined Object	Relation is version of
Media Object	Name, Type, Subject, Description, Date Created, Technique, Creator, Format Extent, Rights, Skill Level, Person Effort



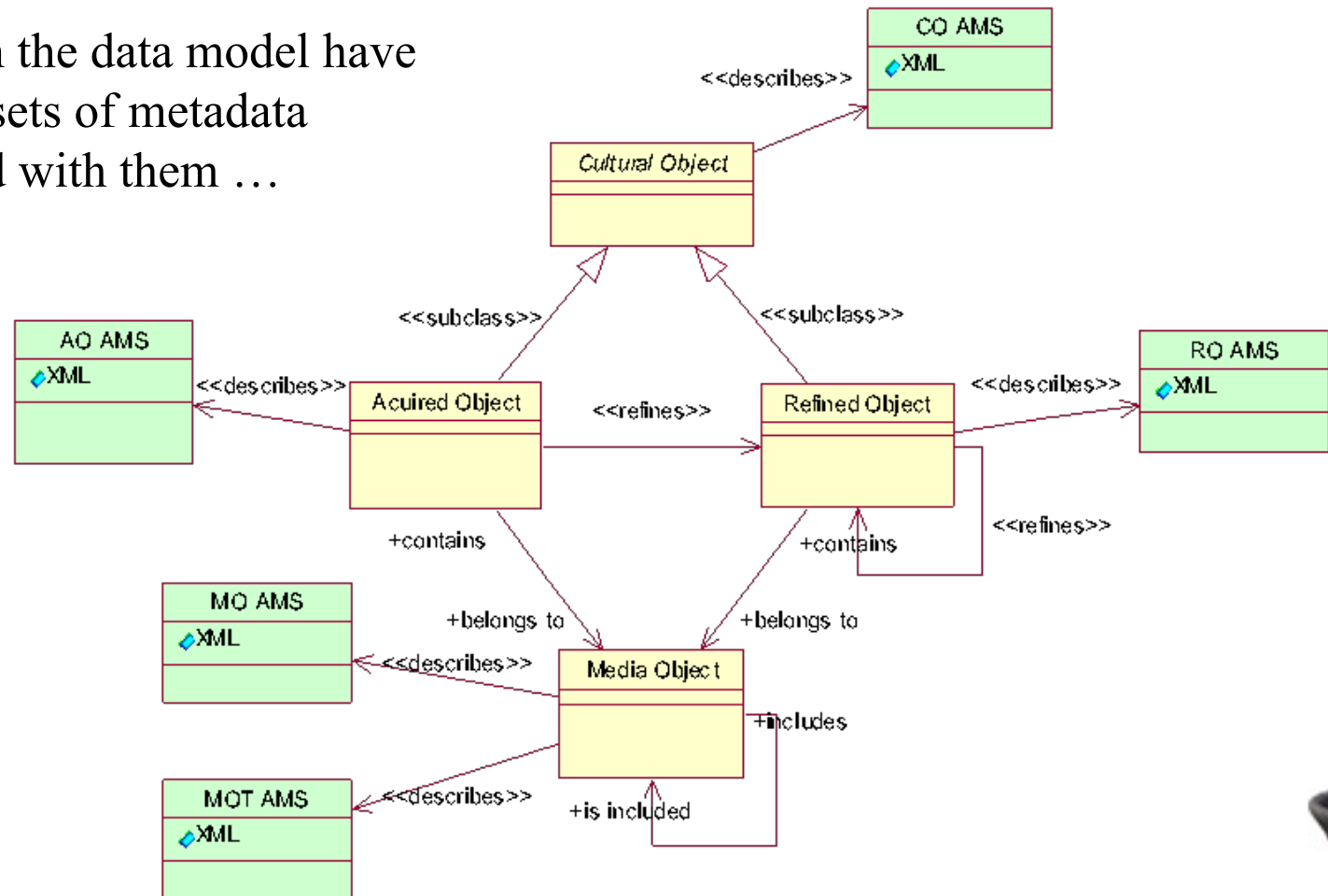
AMS Vocabulary Terms (2)

Type of Metadata	AMS Vocabulary Terms
Media Type Specific	
Simple Image	Image Size, Resolution, Compression Method, Compression Factor, Colour Depth
Description	Length, Character Set
3D Studio Max Project	Software version, Required Extensions
VRML Model	VRML Version, Number of Textures, Composite, Animated
Panorama Image	Number of Images, Step Angle
Multi-resolution Image	Resolutions, Software, Algorithms



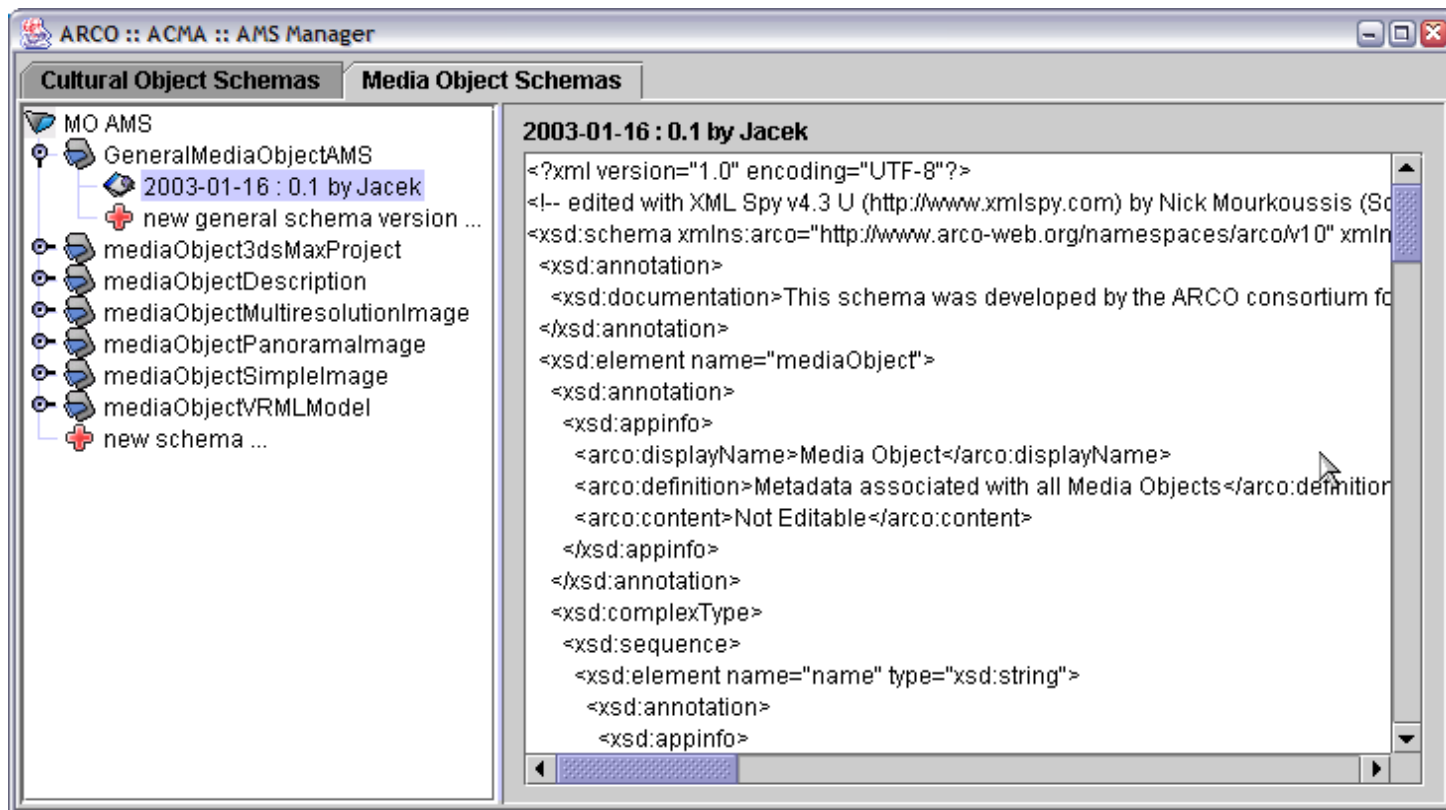
AMS and the ARCO Data Model

Entities in the data model have differing sets of metadata associated with them ...



ARCO Metadata Schema Manager

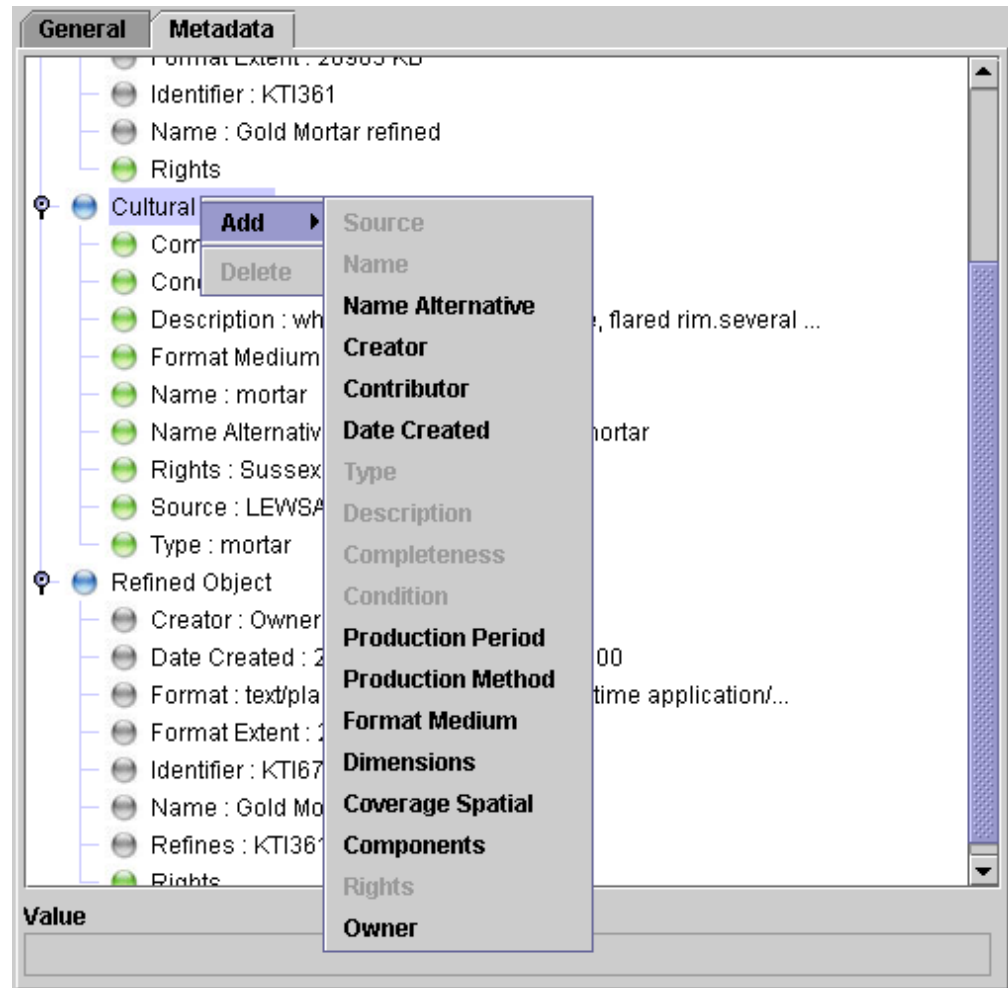
- Caters for evolution of the AMS specification
- Provides ability to add metadata specification for new MOs
- Import and export of metadata specifications



ARCO Metadata Instance Editor

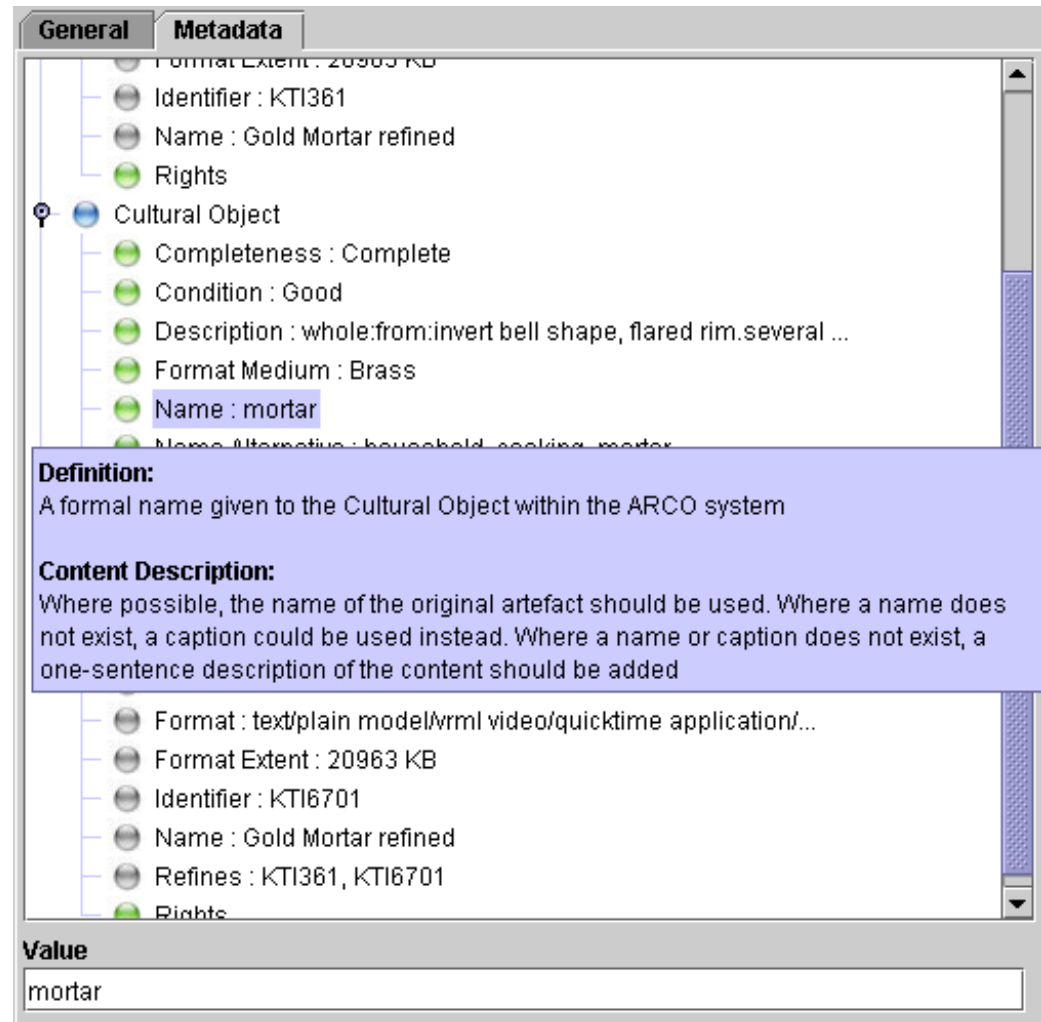
Provides guidance in authoring and editing instance metadata:

- mandatory elements inserted automatically
- every action is verified against a schema specification
- auto-generation of some technical elements (e.g. *Format Extent* –size in bytes)
- enumerations or controlled vocabularies displayed in drop-down menus



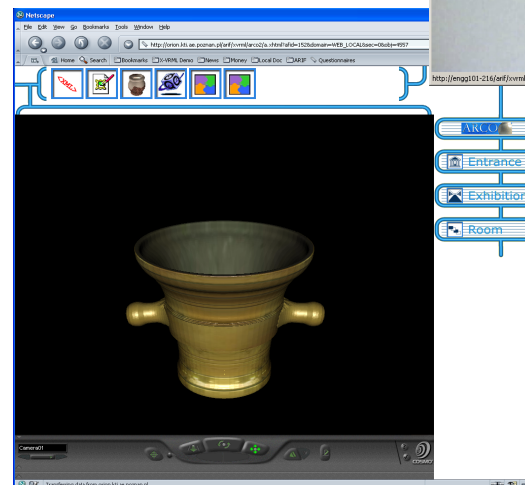
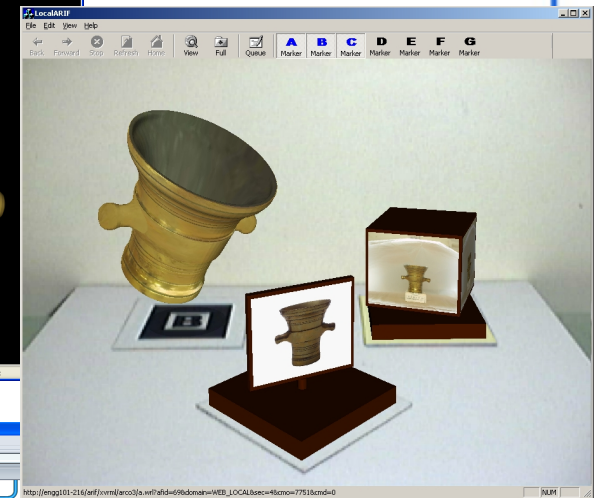
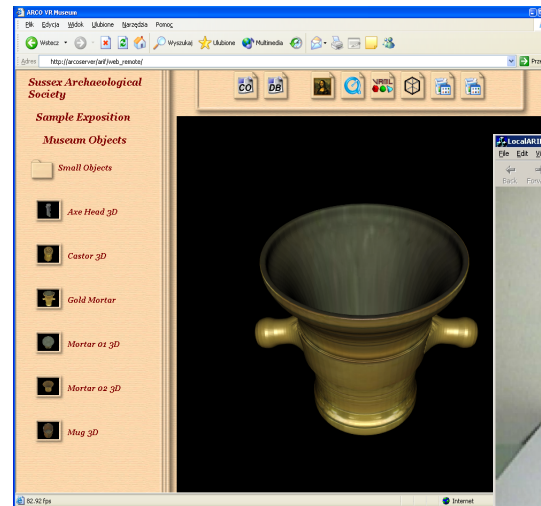
ARCO Metadata Editor: Content Guidelines

Content guidelines or cataloguing rules are displayed if provided by the schema creator ...



Visualisation of digitised artefacts

- Visualisation of ARCO media objects from the database
 - VRML models, metadata, images, virtual exhibitions
- Three visualisation interfaces, same database contents
 - Remote web interface (search, browse)
 - Local museum touch-screen (search, browse)
 - Local augmented reality environment (interact)



Metadata display over the Internet

Web interface caters for browsing of exhibition hierarchies and metadata associated with CO, AO, RO and MOs:

The screenshot displays the ARCO web interface. On the left, a vertical navigation pane shows the hierarchy: **Victoria & Albert Museum** > **Queen Victoria** > **Daily Use Objects**. Below this, a list of objects is shown with small thumbnail images: *Only mortars*, *Sub room*, *Castor*, *Cup*, *Match Box*, and *Egg Cup*. The main content area on the right is titled Cultural Object Metadata: and lists the following details for the selected object:

- Source: LEWSA:1964.1.158
- Name: castor
- Name Alternative: trophy
- Type: farming, awards
- Description: whole:form:cylindrical with fitted domed lid.strapwork handle footed base.engraved legend opposite handle
- Completeness: Complete
- Condition: Good
- Production Method: engraved
- Format Medium: Brass
- Rights: Sussex Past

At the top of the main content area, there is a toolbar with icons for CO, DB, a portrait, a magnifying glass, VRML, a cube, and two building icons.

Touch-screen display in a museum

Touch screen displays can be used within museums to browse and search for particular exhibitions or objects:


Cultural Object's Metadata search

in name find word castor


and in format medium find word brass

and not in anywhere find word PL

more less




Search



Entrance

Cultural Object Metadata search results:

Found: 3 result(s).




Castor

whole:form:cylindrical with fitted domed lid.strapwork handle footed base.engraved legend opposite handle

... <source>LEWSA:1964.1.158</source>

<name>castor</name>

<nameAlternative>trophy</nameAlter...




Brass Castor

whole:form:cylindrical with fitted domed lid.strapwork handle footed base.engraved legend opposite handle

... <source>LEWSA:1964.1.158</source>

<name>castor</name>

<nameAlternative>trophy</nameAlter...



Castor refined KTI

whole:form:cylindrical with fitted domed lid.strapwork handle footed base.engraved legend opposite handle

... <source>LEWSA:1964.1.158</source>

<name>castor</name>

<nameAlternative>trophy</nameAlter...

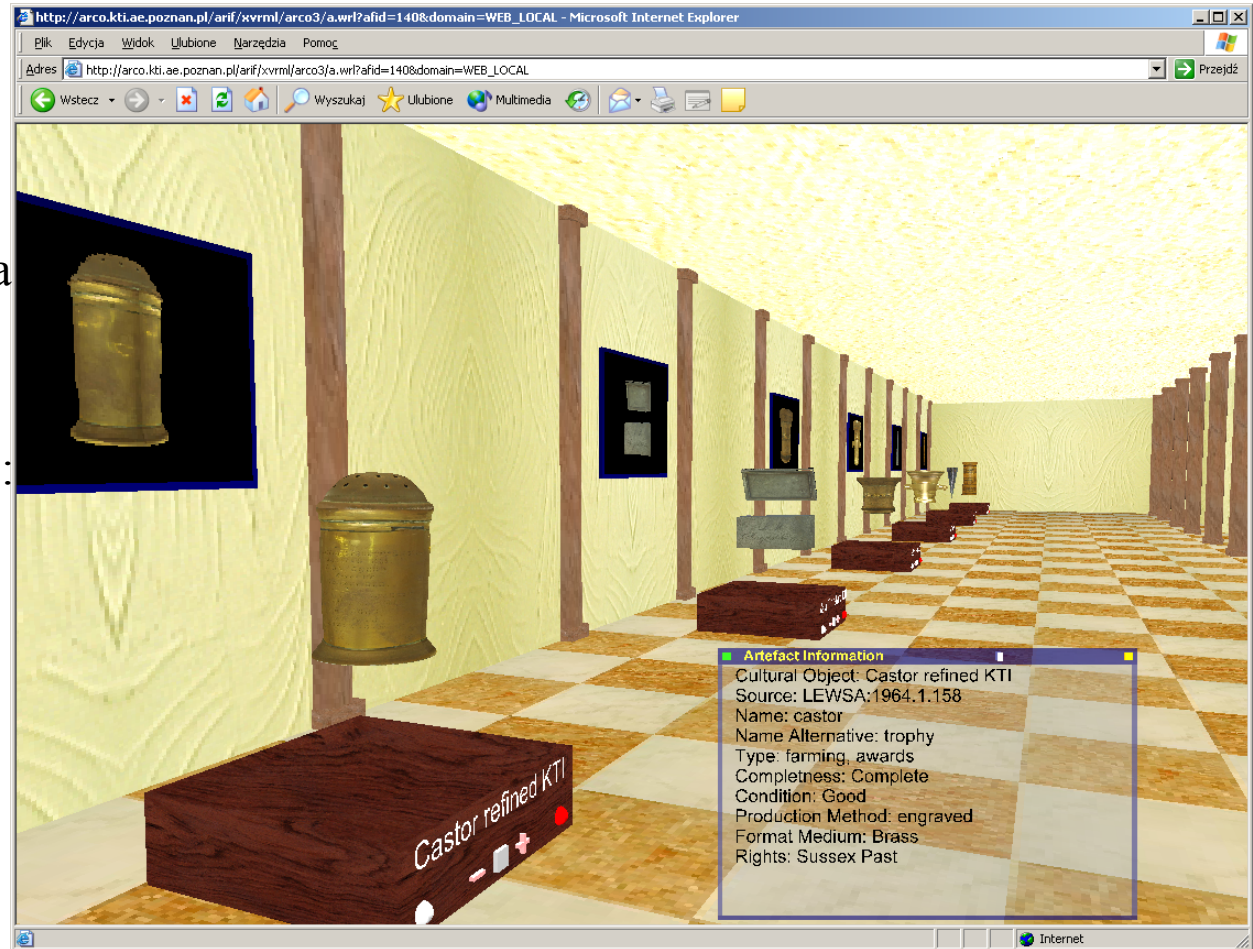
www.arco-web.org

Department of Computer Science Seminar, University of Bath, 9th January 2004

A virtual exhibition as a 3D Gallery

Users can browse objects by walking along the gallery:

- detailed information via interaction elements integrated into stands
- interaction with objects: zoom, rotate, reset
- optional semi-transparent window for metadata display
- metadata updated to correspond with closest object



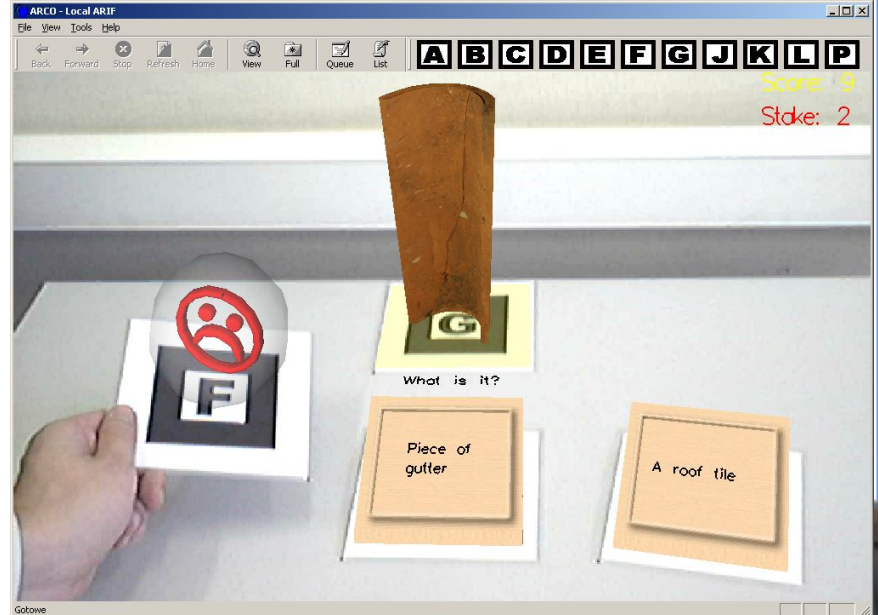
An Interactive Cultural Heritage Book

A more engaging way of browsing exhibitions ...



An Interactive Learning Scenario

- A 3D model and a question are displayed on physical markers
- Three possible answers are assigned to three other markers
- The user can answer the question by turning over one of the markers
- Depending on whether the answer is correct or not, an appropriate response appears in the augmented reality scene ...



Conclusions

- ARCO is developing an open architecture that integrates state-of-the-art with ARCO specific technologies to enable museums to build virtual exhibitions
 - Digitisation and modelling of 3D museum artefacts
 - Refinement and creation of the 3D virtual museum artefacts
 - Object relational database and content management
 - Visualisation of museum exhibits in virtual environments
 - Integrated through XML technologies (X-VRML, AMS, XDE)
- The system can be used to serve a didactic function as well as enhancing the experience of cultural objects through interaction
- Metadata plays a central role in enabling and supporting system functionality
- Visit us at the ARCO website:
 - <http://www.arco-web.org/>

